Polaris 4-channel AIS Receiver

Introduction

The Satlab Polaris AIS is a fully self-contained software-defined radio receiver for the maritime VHF band, with integrated demodulators for reception of standard and long-range AIS messages. This versatile SDR offers excellent performance given the typical size, weight and power constraints of a CubeSat — or as an additional payload on larger LEO satellites.

Features

- Stand-alone 4-channel AIS receiver
- Integrated LNA and SAW filters
- Onboard data storage for AIS frames
- Time tagging with external PPS input
- Center frequency and power estimate for each received AIS message
- Support for channelized spectrum streaming over Ethernet
- Safe on-orbit software upgrade support
- CAN-bus, RS-422 and Ethernet interfaces using CubeSat Space Protocol (CSP)
- Delivered with support library for easy integration
- Wide input voltage range with protection
- Integrated temperature and power monitoring
- CubeSat Kit compatible aluminum enclosure
- ESD protection on all interfaces

Key Parameters

Parameter	Specification
AIS channel frequencies	156.775, 156.825, 161.975, 162.025 MHz
Sensitivity	−121 dBm (80 % reception rate)
Co-channel rejection	7 dB (80 % reception rate)
Time tagging accuracy	3.6 µs @ −121 dBm, 1 µs @ −110 dBm
Frame store capacity	261120 frames
Input voltage	4.5 V to 40 V
Typical power consumption	1500 mW (5 V input, 25 °C)
Operating temperature	−40 °C to +85 °C
CAN-bus	Up to 1 Mbit/s
RS-422	Full duplex, up to 3 Mbit/s
Ethernet	Full duplex, 100 Mbit/s
Primary storage	128 MB NOR-flash
Secondary storage	1 GB SLC SD card
Dimensions	87.2 x 93.0 x 12.5 mm
Mass	185 g

© 2025 Satlab A/S - https://www.satlab.com

Table of Contents

1 Description

Polaris AIS is Satlab's second generation Satellite-AIS receiver, based on the in-orbit experience gained from the QubeAIS receiver which has flown on several missions since 2013.

The Satlab Polaris AIS is a fully self-contained software-defined radio receiver for the maritime VHF band, with 4-channel integrated demodulators for reception of standard and long-range AIS messages. This versatile SDR offers excellent performance given the typical size, weight and power constraints of a CubeSat — or as an additional payload on larger LEO satellites.

The receiver uses a high-performance, direct-conversion front-end and large dynamic range ADC to receive the entire maritime VHF band. Digital filtering and down conversion is used to extract and demodulate the 4 AIS channels in parallel. The board features on-board low noise figure LNA and SAW filters and only requires a passive VHF antenna for reception.

All 1–5 slots Class-A/B AIS messages are supported, including type 27 long-range messages. The demodulation algorithm uses per-packet adaptive filtering and center frequency estimation, which ensures good reception even for weak messages at large Doppler frequency offsets. The product can safely be upgraded on-orbit, if new firmware is released. Additionally it is also possible to stream the 4 filtered AIS channels with UDP over Ethernet, making it possible to use the Polaris AIS as a digitizer to either store the spectrum or implement a demodulator on another subsystem in the satellite.

On-board data storage simplifies integration, allowing received AIS messages to be queried directly from the receiver without intervention from the spacecraft OBC. The receiver can also be operated in a receive-and-forward mode if an external message store is preferred.

Figure 1 shows the Polaris AIS with external interfaces to the satellite bus and receiving VHF antenna.

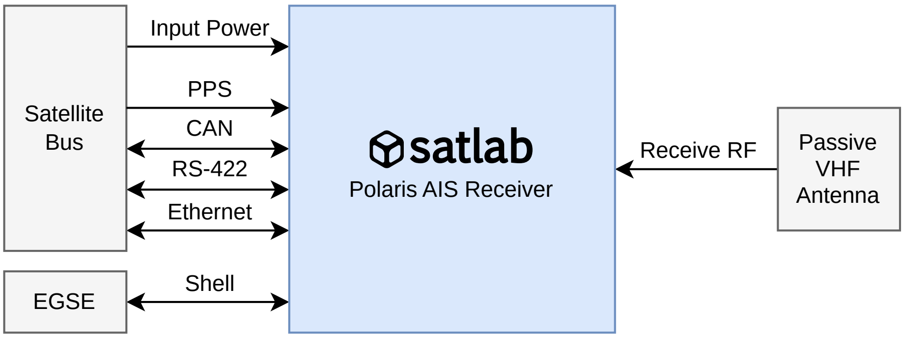


Figure 1: Overview of the Satlab Polaris subsystem external interfaces

Polaris AIS is powered from a single 4.5 to 40 V input voltage and is compliant with ECSS-E-ST-20-20C, 28 V unregulated power supplies. The power input and all onboard regulated voltages are protected against over-current.

The receiver is delivered in a milled aluminium enclosure which provides a strong mechanical interface as well as EMI shielding and thermal contact. The main and EGSE connectors are latching, high-reliability Harwin Gecko connectors with gold-plated contacts. A full detent Amphenol coaxial SMP connector is used for the antenna input.

The board is operated via CAN-bus, RS-422 or Ethernet using Cubesat Space Protocol[1] (CSP) commands. Multiple communication interfaces can be enabled simultaneously and serve as backup. Satlab supplies client libraries in C and Python to wrap the CSP protocol, along with example code to simplify integration even further.

A serial command line shell is available through the EGSE connector, which can be used for on-ground configuration, testing and performance verification.

---

[1] See `http://www.libcsp.org` for documentation on the open source reference implementation.

2 Receiver Performance

In figure 2 the typical measured reception performance for the AIS receiver is shown for the 4 AIS channels at room temperature. The intersections with the dashed line shows the −121 dBm power level required for the receiver to receive 80 % of transmitted frames. Long-range messages transmitted on 156.775/156.825 MHz contain fewer bits, so the probability of error-free reception is slightly higher on these channels, leading to a marginally higher sensitivity.

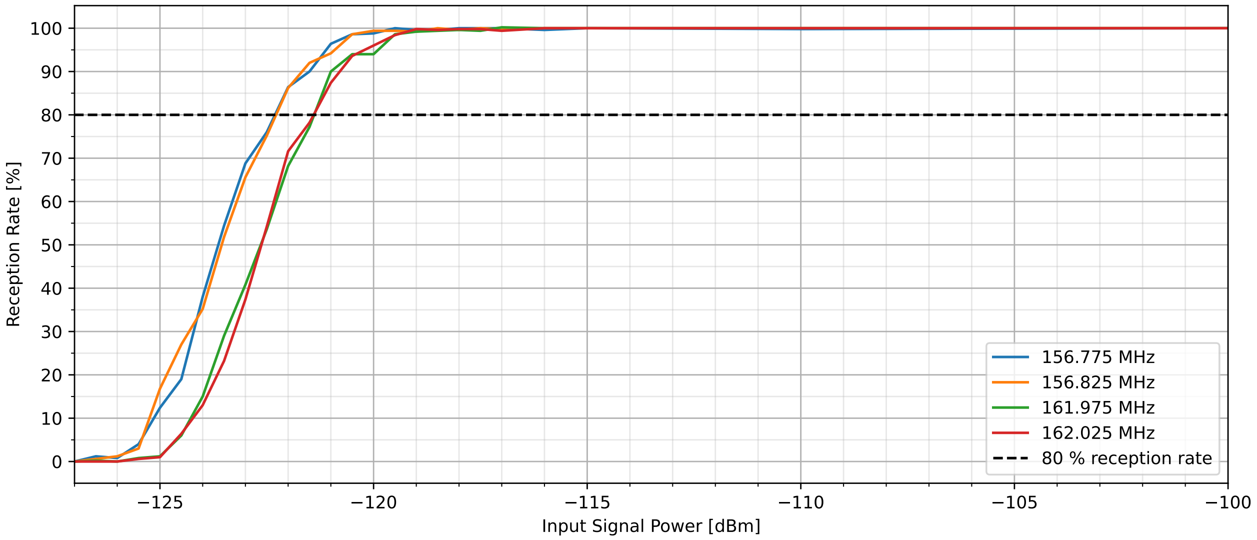


Figure 2: Typical receiver performance as a function of signal power on the 4 AIS channels

This sensitivity level can be related to a simplified link budget. The basis of the calculation is a Class A vessel with a vertical antenna, illustrated in figure 3. The ship transponder output is assumed to be 12.5 W, with 1 dB loss from transponder to the antenna. The 3 ship antenna types are assumed over an ideal ground plane and on the satellite side a 0 dBi antenna and 1 dB cable loss is assumed. This results in the signal levels into the receiver as shown in figure 4 for a 500 km orbit. The dashed lines show the reception limit for the receiver, showing that with the default settings, the signal power falls within the operating range of the AIS receiver, even at the longest slant range.

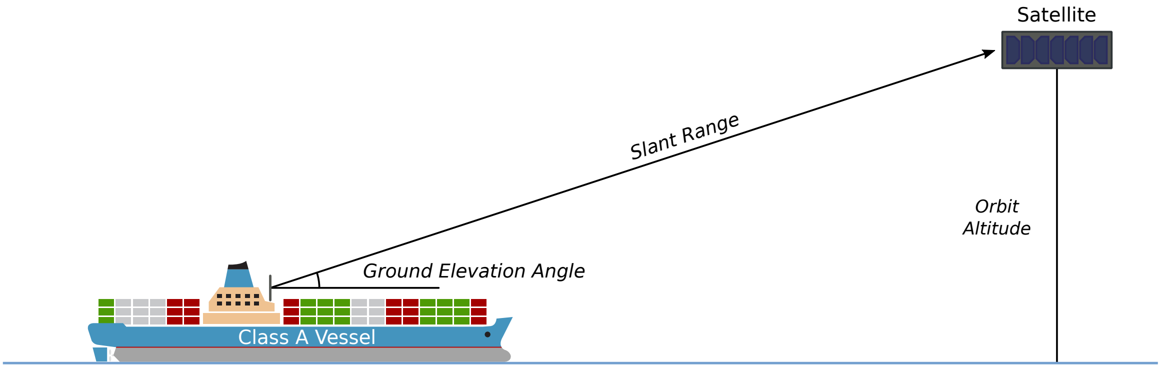


Figure 3: Simplified link budget simulation setup

Class-B transponders transmit with 2 W output power, so given the same antenna model assumptions on the ship, the received signal powers will be 8 dB lower than a class-A vessel.

It should be noted that this is a very simplified calculation and a detailed link budget analysis should be performed for each individual mission.

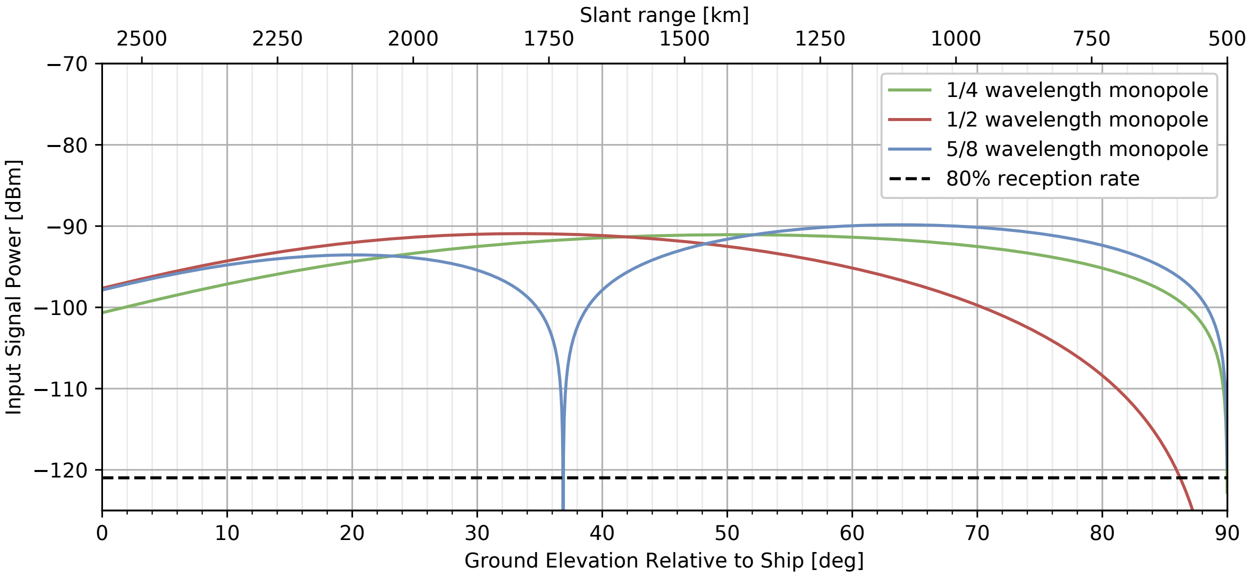


Figure 4: Estimated received signal power into the receiver with various ship antennas

3 Hardware Overview

This section provides a high-level overview of the Polaris AIS platform hardware, with descriptions of the RF front end, baseband processing system, power domains and telemetry.

3.1 RF Front End

The receiver uses a direct-conversion, low-IF quadrature front end in conjunction with a 16-bit, 25 Msps dual channel ADC. This allows a single front end to be used for receiving all AIS channels in the maritime VHF band simultaneously. Figure 5 shows the main receiver hardware components. Buffers and ADC drivers are not shown for simplicity.

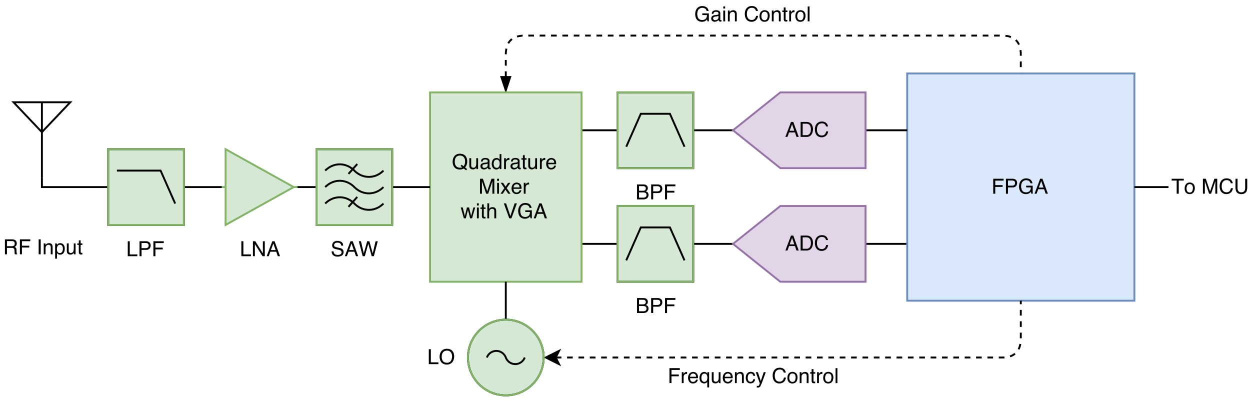


Figure 5: Overview of the RF hardware structure

The receiver requires a single VHF antenna connected to the RF connector. The Low Pass Filter (LPF) reduces the influence of strong nearby transmitters, such as satellite downlink in the UHF- and S-band. If the satellite uses downlink in the VHF band, please consult Satlab before ordering.

The on-board LNA ensures a good noise figure for the overall system, and simplifies the final integration process as the system only requires a passive antenna.

Out-of-band rejection is ensured both by the on-board SAW filter and the IF band pass filters. The SAW filter covers the maritime band allowing the FPGA to receive 156 MHz to 162.025 MHz via dual 16-bit ADCs running at 25 Msps. The VCO is internally divided in the mixer to generate an upper-side LO, significantly reducing any LO leakage.

The quadrature mixer has a built-in VGA with adjustable gain that can be set via telecommands.

The FPGA converts the wideband complex input stream into one filtered baseband output stream per AIS channel. Internally the FPGA uses multiple filtering and decimation stages to maintain the dynamic range needed when receiving from many different transmitters at the same time.

3.2 Baseband Processing

The MCU receives demodulated AIS messages from the FPGA and connects to data storage and communication interfaces. Figure 6 shows the MCU and connected peripheral devices.

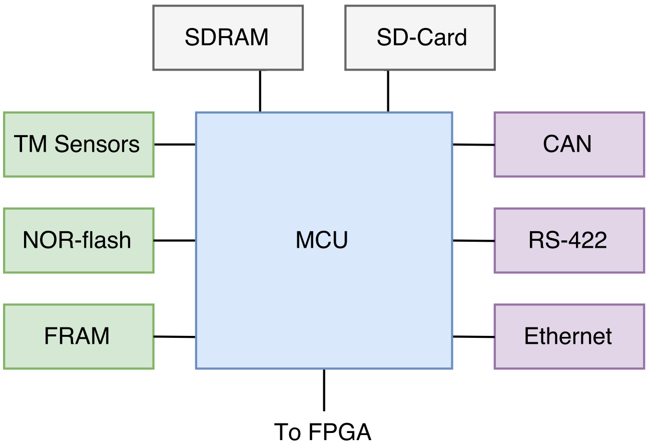


Figure 6: Overview of the MCU with data storage and communication interfaces

A 128 MB NOR-flash is used as the primary storage for received AIS messages. A 1 GB SD card is used as secondary storage for raw samples, software uploads and snapshots of the AIS store. The FRAM is used to store non-volatile configuration parameters such as CSP address and communication interface settings. CAN-bus at 1 Mbit/s is the default interface, with RS-422 and Ethernet powered down by default. These interfaces can be enabled permanently or by command, e.g. when the spacecraft is within range of a high speed ground link.

The board contains an external 64 MB SDRAM which is disabled by default to limit power consumption, and not required for normal AIS reception on the device. The external memory is used when capturing raw samples, and is automatically enabled on sample requests.

Temperature and power sensors for telemetry are connected on a dedicated telemetry bus.

The MCU and FPGA are connected using a unidirectional serial link for multiplexed data transfer and a bidirectional SPI bus for configuration.

3.3 Power Domains and Telemetry

Figure 7 shows a simplified diagram of the power domains, protection and monitoring of the device. The input protection circuitry guards the board against over-voltage and reverse-voltage conditions, and performs active inrush current limiting and over-current protection. Refer to the Electrical Specifications section for the protection limits and recommended operating conditions. The external watchdog/reset timer is powered from V_{IN} with a current-limiting 3.3 V LDO and resets the main regulator on system power-on or in case of watchdog timeout. This ensures that all components on the board are reset to a known state when the system boots.

During power-on of the device, the inrush current is limited only by the voltage slope and the input capacitance of 1 µF in series with a 1 Ω resistor. In this moment the spacecraft Power Distribution Unit (PDU) or Electronic Power Supply (EPS) is responsible for keeping current spikes at a reasonable level. Once the input voltage is above the minimum threshold (max 4.5 V) the internal protection circuit is enabled and active current limitation of 2 A is used during system power on and operation. The protection reset timer of 420 ms actively discharge internal power nets before powering the MCU and FPGA using a strictly defined startup sequence.

The main buck converter converts V_{IN} to 3.3 V which powers the MCU and FPGA I/O, and the 2.0 V and 1.0 V converters. Power for the MCU core, ADC and FPGA I/O is generated using LDOs from the 2.0 V rail. The MCU controls the power for the RF, FPGA and ADC domains using GPIOs.

The SD card and Ethernet PHY are powered off by default and must be powered on by the MCU. Both load switches are current limiting.

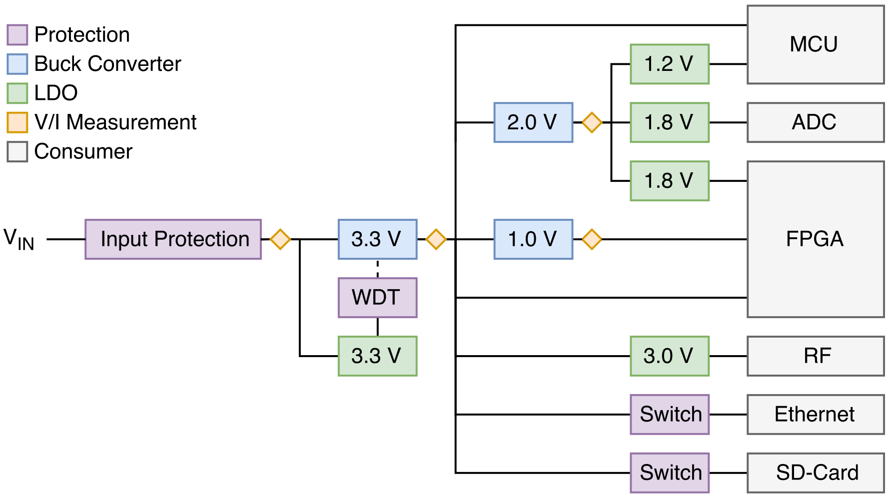


Figure 7: Power domains and protection circuitry

Each local power domain of the receiver features over current protection for error mitigation purposes, to reduce the impact of any Single Event Latchup (SEL) events. Voltage, current and power can be measured on the V_{IN}, 3.3, 2.0 and 1.0 V rails and can be downloaded using telemetry properties. The measurement points are marked in figure 7 with yellow diamonds. Note that the V_{IN} sensor is placed after the input protection circuitry, which has a equivalent series resistance of approximately 140 mΩ, so the measured voltage and power are lower due to the corresponding voltage drop. It should also be noted that the 1.0 and 2.0 V supplies are generated from the 3.3 V rail, so the 3.3 V power measurement includes the power used by the two other rails.

The board has six temperature measurement points, located near key components on the PCB. The temperature and power sensors are listed in table 1 along with their telemetry property name.

Table 1: Onboard telemetry sensors

Property	Description
`tm.{volt,cur,power}.vin`	V_{IN} voltage, current and power
`tm.{volt,cur,power}.3v3`	$V_{3.3\,V}$ voltage, current and power
`tm.{volt,cur,power}.2v0`	$V_{2.0\,V}$ voltage, current and power
`tm.{volt,cur,power}.1v0`	$V_{1.0\,V}$ voltage, current and power
`tm.temp.mcu`	MCU, SDRAM and NOR-flash temperatures
`tm.temp.fpga`	FPGA junction temperature
`tm.temp.power`	1.0/2.0 V buck converters temperature
`tm.temp.lna`	LNA and front end components
`tm.temp.adc`	ADC temperature
`tm.temp.sdcard`	SD card temperature

4 Software Overview

Figure 8 shows the main software components and data flow in the Polaris AIS receiver. The software can be grouped in two main parts: the bitstream for the FPGA and firmware for the MCU. This section describes the operation of each component.

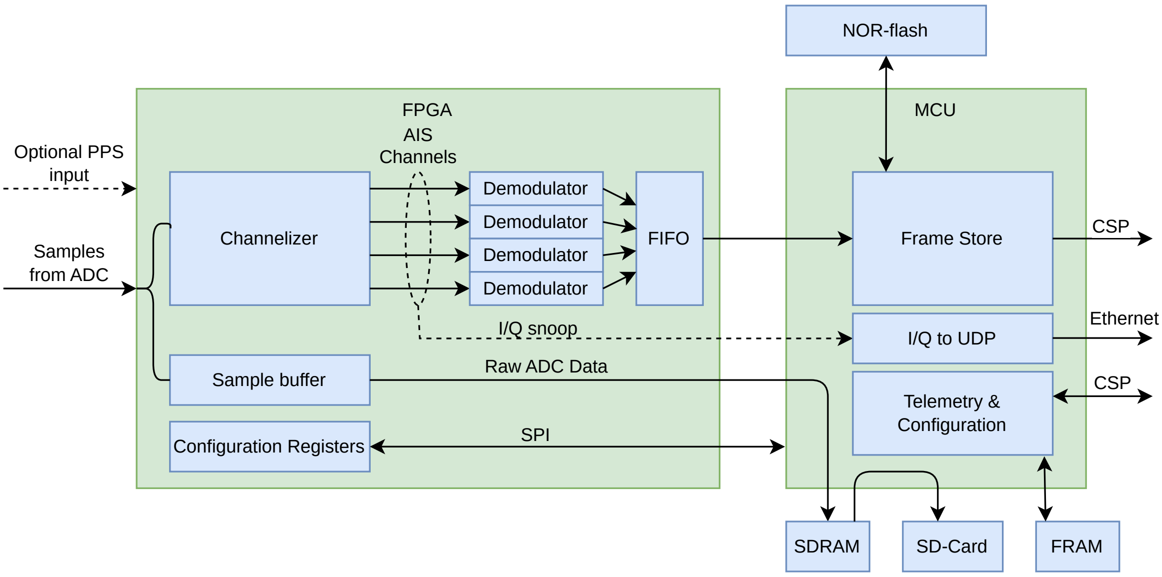


Figure 8: Overview of the receiver software components.

The system always boots from internal NOR-flash on the MCU with the RF components and FPGA powered down. The flash sectors are divided into two equally sized image slots and a special section in FRAM is used to select the preferred image. New receiver firmware can be uploaded to the SD card via CSP, and each image slot can update the firmware in the other slot remotely. Firmware images contain both the main application and the matching embedded FPGA bitstream, allowing synchronized on-orbit update of both.

The receiver is operated remotely using CSP commands via one of the external communication interfaces.

4.1 FPGA Bitstream

The FPGA is automatically powered on and loaded by the MCU during startup of the AIS demodulators. The bitstream contains a channelizer to convert the 25 Msps ADC input stream to one filtered, 96 ksps, complex baseband output stream per AIS channel. The channelized data is demodulated in 4 independent demodulators, one for each AIS channel. AIS messages from the demodulators are forwarded to the MCU, which handles storing and communication with the satellite bus. If the optional PPS input is supplied, the ADC clock frequency will be disciplined and the AIS messages will be accurately timestamped. The rising edge of the PPS is used as the start of a second. Various parameters, such as telemetry counters for the demodulators, are available through configuration and telemetry parameters.

The bitstream also implements a small internal sample buffer with a capacity of 8192 complex 16-bit samples, i.e. approximately 327 µs at 25 Msps. A capture to the buffer can be triggered via CSP command and the data downloaded from either SDRAM or the SD card. Because of the short capture length, this feature is mainly useful to check for interferers in the full spectrum data, on ground or after launch. It is possible to continuously forward the 96 ksps complex baseband channels via UDP over the Ethernet interface to stream the data to another subsystem, that can then either store it or implement a custom demodulator. This feature can be enabled in parallel with the normal AIS reception of the payload.

4.2 MCU Firmware

The MCU firmware implements a real-time operating system, device drivers for internal and external peripherals, frame storage and CSP servers for telecommands and telemetry.

4.2.1 Message Store

Each received message is tagged with a 32-bit sequence number and stored in NOR-flash with reception metadata (estimated center frequency offset, signal level) and a 64-bit timestamp (number of nanoseconds since midnight on January 1st, 1970). All 1–5 slot messages are stored in the same store, and consumes 256 bytes of NOR flash, including metadata, independent on the number of slots in the message. The store is a ring buffer and wraps around every 261120 messages.

Frames can be selectively downloaded by their sequence number through the store CSP service, and provides access to the full AIS messages and metadata. The entire store can also be dumped as a binary file to the SD card for more efficient download. It is of course possible to clear all stored data.

4.2.2 CSP Services

Three CSP servers are used to configure the receiver, read back status and to download messages and raw samples. File transfer is handled using the Blob Transfer Protocol (BTP), a lightweight file transfer protocol built on CSP that is used to provide reliable transfer of raw sample files and firmware images.

4.2.3 Debugging Shell

The system provides a serial shell on the RX/TX pins in the EGSE connector (see section 5.2). The serial configuration is 8N1 at 115 200 Bd, and the console requires an “Enter” key press to be activated.

Listing 4.1 shows the nominal output on the EGSE shell during boot. A number of timestamped log messages are printed during boot from various logging groups. Additional logging can be enabled at runtime using the `trace` commands. The `help` command can be used to list available commands and their usage.

The installed software version and build information is also printed in the EGSE shell during boot.

Listing 4.1: Example output from EGSE shell

```
Satlab Polaris AIS bootloader v2.0.0
boot slot 0 (2 remaining attempts)

[    0.000317] system: Copyright (c) 2016-2025 Satlab A/S <satlab@satlab.com>
[    0.001439] system: boot slot: 0 count: 1 reset cause: general reset
[    0.002682] system: board serial #20123456
[    0.008406] prop: using stored sys properties
[    0.009853] prop: using stored demod properties
[    0.016572] prop: using stored cal properties

Satlab Polaris AIS v2.0.0

[polaris] help
Available commands:
boot            Bootloader commands
csp             CSP commands
echo            Display a line of text
fs              File system commands
help            Show available commands
history         Show previous commands
prop            System configuration properties
reboot          Reboot system
store           Frame store commands
time            Time command execution
```

```
tm              Telemetry commands
trace           Trace subcommands
uptime          Show system uptime
watch           Run command periodically
```

4.3 Configuration & Telemetry

Configuration, status and telemetry download from the device is handled using a number of property variables. Each variable has a type (signed/unsigned integers of various sizes, floating point numbers, strings, etc.) and a default value. Some properties are used for configuration and can be modified and stored in (optionally write-protected) non-volatile memory using the EGSE shell or remotely via CSP commands. Others are read-only and used for telemetry purposes. These properties are periodically updated by the system during operation, and can also be viewed using either the EGSE shell or via CSP.

Some property changes take effect immediately, while others require a store and a system reset after update.

The system properties are divided into a number of property groups, each covering a specific part of the firmware. Property values can be read and updated from a remote system using CSP. The `prop-client` support library contains wrapper functions around the CSP protocol to read and update properties. The `satctl` Linux application can be used as a reference for the use of the library.

4.3.1 Configuration

On boot, the system tries to load stored properties from FRAM. Default settings are hardcoded into the receiver firmware and used as fallback values if no valid stored properties are found.

It is possible to change properties runtime without saving them to FRAM. It is strongly recommended not to alter write-protected properties on-orbit (e.g. CSP address), since setting them to a invalid value could render the receiver unresponsive.

Listing 4.2 shows the use of the `prop list` command to show properties and their values from the `store` and `demod` groups.

Listing 4.2: List properties and values from the `store` and `demod` groups

```
[polaris] prop list store
Property        Type      Value
enable          bool      true
seq             u32       1381198
stored          u32       260984
[polaris] prop list demod
Property        Type      Value
enable          bool     true
decoded         u32      6551 frames
iq.enable       bool     false
iq.dest.ip      str      192.168.100.21
rate            u16      116 frames/min
rf.gain         flt      0.000000 dB
pwr.min         flt      -127.000000 dBm
pwr.offset      flt      0.000000 dB
pps.valid       bool     true
pps.last        u32      24999747
pps.avg         u32      24999748
pps.synced      bool     true
pps.time.set    bool     true
```

4.3.2 Telemetry

The property system is also used to read the telemetry variables from the Polaris AIS receiver. Telemetry values are updated every second and are available through the `tm` property group. The example below shows the use of the `tm show` shell command which uses the property system to read and output formatted telemetry values. In the example, the board is connected to a 5.0 V bench supply without sense connection. The average board temperature seems to be around 34.5 ℃ with the FPGA junction temperature at 38.50 ℃.

Listing 4.3: List telemetry properties and values

```
[polaris] tm show
Power Channels
FPGA          On
RF            On
SD-card       Off
Ethernet      Off

Power Rails
VIN       4875.00 mV   305.00 mA  1489.00 mW
3V3       3326.00 mV   416.00 mA  1386.00 mW
2V0       1995.00 mV   170.00 mA   340.00 mW
1V0        955.00 mV   441.00 mA   420.00 mW

Temperature Sensors
MCU         33.81 C
FPGA core   38.50 C
Power       32.56 C
LNA         34.00 C
ADC         34.56 C
SD-card     33.06 C
```

5 Qualification

The Polaris AIS receiver has been through a number of test campaigns to verify its performance over temperature, vacuum, vibration and radiation. An overview of the testing performed on the receiver is shown in table 2. As this list is non-exhaustive, please contact Satlab for further information if needed.

Table 2: Qualification Parameters

Parameter	Value
Thermal soak	−40 ℃ to +85 ℃
Vibration	14.1 G_{rms}
TID	20 kRad(Si) board level

It should be noted that the levels which are listed in table 2 is a superset of the different tests the receiver has been through during various test campaigns.

5.1 Acceptance Testing

As part of acceptance testing, each delivered board has been subject to a full RF performance test covering the temperature interval from −30 ℃ to +70 ℃, the power interval from −126 dBm to −10 dBm and on the 4 nominal AIS frequencies: 161.975 MHz, 162.025 MHz, 156.775 MHz, 156.825 MHz.

5.2 Connector Pinout

P1 and P2 are latching, high-reliability Harwin Gecko connectors with 1.25 mm pitch and gold-plated contacts. P1 (G125-MH11605L3P) is the main connector for power and communication interfaces. P2 (G125-MH10605L3P) is used for the EGSE shell and programming via SWD. Typically, the P2 connector is only used for test and firmware upgrade on ground and left unconnected in flight configuration. The EGSE UART can be connected to another system in the spacecraft if desired, as the board includes protection against being supplied from these pins. It is strongly recommended to leave the JTAG/SWD pins unconnected in flight configuration.

The Polaris receiver is supplied with termination resistors on the CAN-bus (120 Ω) and on the RS-422 receive pair (100 Ω). The Ethernet connection is designed to be used in systems both with and without magnetics. When using magnetic-less Ethernet a set of external DC blocking capacitors must be used (not included on the board).

The coaxial RF connector is a full detent SMP (Amphenol SMP-MSFD-PCE-1).

The P1 and P2 connector pinout is shown here together with the pin numbering of the male connectors. “TX” pins denote output pins from the system and “RX” pins are inputs to the system.

ESD suppression with TVS diodes has been added to all pins in the three connectors. However, proper care should still be observed while handling the device.

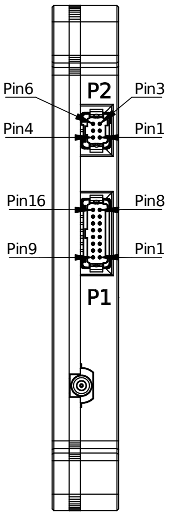
P1 — Main Connector

VIN	16	8	VIN
PPS	15	7	DNC
GND	14	6	GND
RS-422 RX-	13	5	RS-422 RX+
RS-422 TX-	12	4	RS-422 TX+
CAN-L	11	3	CAN-H
ETH RX-	10	2	ETH RX+
ETH TX-	9	1	ETH TX+

P2 — SWD/Serial EGSE connector

Debug TX	6	3	SWDCLK
V_{Target} (sense)	5	2	GND
Debug RX	4	1	SWDIO

DNC = Do Not Connect



ATTENTION: Although all external interfaces on the Polaris AIS are protected against ESD, proper precautions must still be observed when handling the device. Ensure proper grounding, either through an antistatic wrist strap and/or floor mat.

6 Electrical Specifications

All electrical parameters in all tables are specified under the following conditions, unless stated otherwise:

- Typical values are based on T_{AMB}=25 ℃ and V_{IN}= 5.0 V, by production test and/or design characterization.
- Minimum and maximum values represent the worst conditions across supply voltage, process variation, and operating temperature.

6.1 Absolute Maximum Ratings

The table below lists the minimum and maximum allowable levels on the connector pins. Exceeding these may damage the product permanently.

Table 3: Absolute Maximum Ratings

Parameter	Min	Max	Unit
Storage Temperature	–40	85	℃
Input Voltage	–47	47	V
Input Voltage Transient ($<$5 ms)	–60	60	V
RF input power	—	10	dBm
CAN-L/H	–7	12	V
RS-422	–7	12	V
Ethernet	–0.5	5	V
Debug-UART (TTL)	–0.5	5	V
PPS	–0.5	5	V

6.2 Operating Conditions

6.2.1 General Operating Conditions

Table 4: General Operation Condition

Parameter	Min	Typ	Max	Unit
Operational Temperature	–40	—	85	℃
Input Voltage	4.5	—	40	V
Input current (5.0 V and 25 ℃)	—	300	—	mA
Input power (5.0 V and 25 ℃)	—	1500	—	mW
Input power variation over temperature (5.0 V)	—	2	—	mW/℃
Input power variation over supply voltage (25 ℃)	—	15.6	—	mW/V
Power-on threshold, V_{IN} rising	—	4.35	—	V
Power-off threshold, V_{IN} falling	—	4.15	—	V
OVP threshold, V_{IN} rising	—	43.35	—	V
OVP threshold, V_{IN} falling	—	41.05	—	V

6.2.2 Internal Power Specification

Table 5: Internal Power Specification

Parameter	Min	Typ	Max	Unit
$V_{3.3\,\mathrm{V}}$ rail voltage	3.20	3.33	3.45	V
$V_{2.0\,\mathrm{V}}$ rail voltage	1.90	2.00	2.10	V
$V_{1.00\,\mathrm{V}}$ rail voltage	0.92	0.96	0.98	V

6.2.3 Receiver Specification

Table 6: Receiver Specification

Parameter	Min	Typ	Max	Unit
AIS sensitivity (80% reception rate)	—	–121	–120	dBm
Time tagging accuracy:				
Constant 40 °C @ –110 dBm	—	1	1.5	µs
20 °C to 40 °C with 0.5 K/s slope @ 110 dBm	—	2	2.5	µs
Constant 40 °C @ –121 dBm	—	3.6	4.1	µs
20 °C to 40 °C with 0.5 K/s slope @ –121 dBm	—	4.6	5.1	µs
Variable Gain Array setting range	–18	0	28	dB
Variable Gain Array step size	—	0.1	—	dB

6.2.4 Communication Interfaces

Table 7: Communication Interface Specification

Parameter	Min	Typ	Max	Unit
CAN-bus:				
Bit rate	125	1000	1000	kbps
Termination resistor	115	120	125	Ω
CAN-L/H	–2	—	7	V
CAN-L/H recessive level	—	2.3	—	V
CAN-L output dominant level	0.5	—	1.3	V
CAN-H output dominant level	2.4	—	3.35	V
CAN dominant L/H difference	1.1	2.0	3.0	V
RS-422:				
Bit rate	115.2	1000	3000	kbps
Receive termination resistor	—	100	—	Ω
RS-422 RX differential level |Rx+ – Rx-|	0.15	—	6.0	V
RS-422 TX differential output	1.2	2.0	3.5	V
Ethernet:				
Bit rate	100	—	100	Mbps
ETH-TX Out diff. across 100 ohm termination (Assumes 1:1 transformer)	0.8	1.0	1.2	V
PPS (TTL):				
RX input low	0.0	—	1.2	V
RX input High	1.9	—	4.0	V
Debug-UART (TTL):				
TX output high	2.3	3.3	3.4	V
TX output low	0.0	—	0.5	V
RX input low	0.0	—	1.2	V
RX input High	1.9	—	4.0	V

6.2.5 Power-on Sequence and Inrush Current

Table 8: Power ON Sequence

Parameter	Min	Typ	Max	Unit
Power on reset timer	330	420	500	ms
V_{IN} input equivalent at power-on (in series with 1Ω resistor)	0.8	1.0	1.2	µF
Inrush current limiter	1.5	2.0	2.5	A
Current protection limit (3.3 V buck)	1.1	1.25	1.4	A

6.2.6 Current Consumption

Table 9: Current/power consumption at 25 °C

Parameter	Min	Typ	Max	Unit
V_{IN} 5 V, CAN on, Ethernet off, RS-422 off:				
Current	—	300	330	mA
Power	—	1500	1650	mW
V_{IN} 28 V, CAN on, Ethernet off, RS-422 off:				
Current	—	65	72	mA
Power	—	1820	2016	mW
Additional power for enabled features @ V_{IN} 5 V:				
Add for SDRAM enabled	—	80	—	mW
Add for Ethernet enabled	—	185	—	mW
Add for RS-422 enabled	—	110	—	mW

7 Board Outline

Figure 9 shows the receiver from the top side and from the connector side. Note that the four mounting holes use the “CubeSat Kit” (PC/104) layout and are not symmetrical. CAD models are available on the Satlab website.

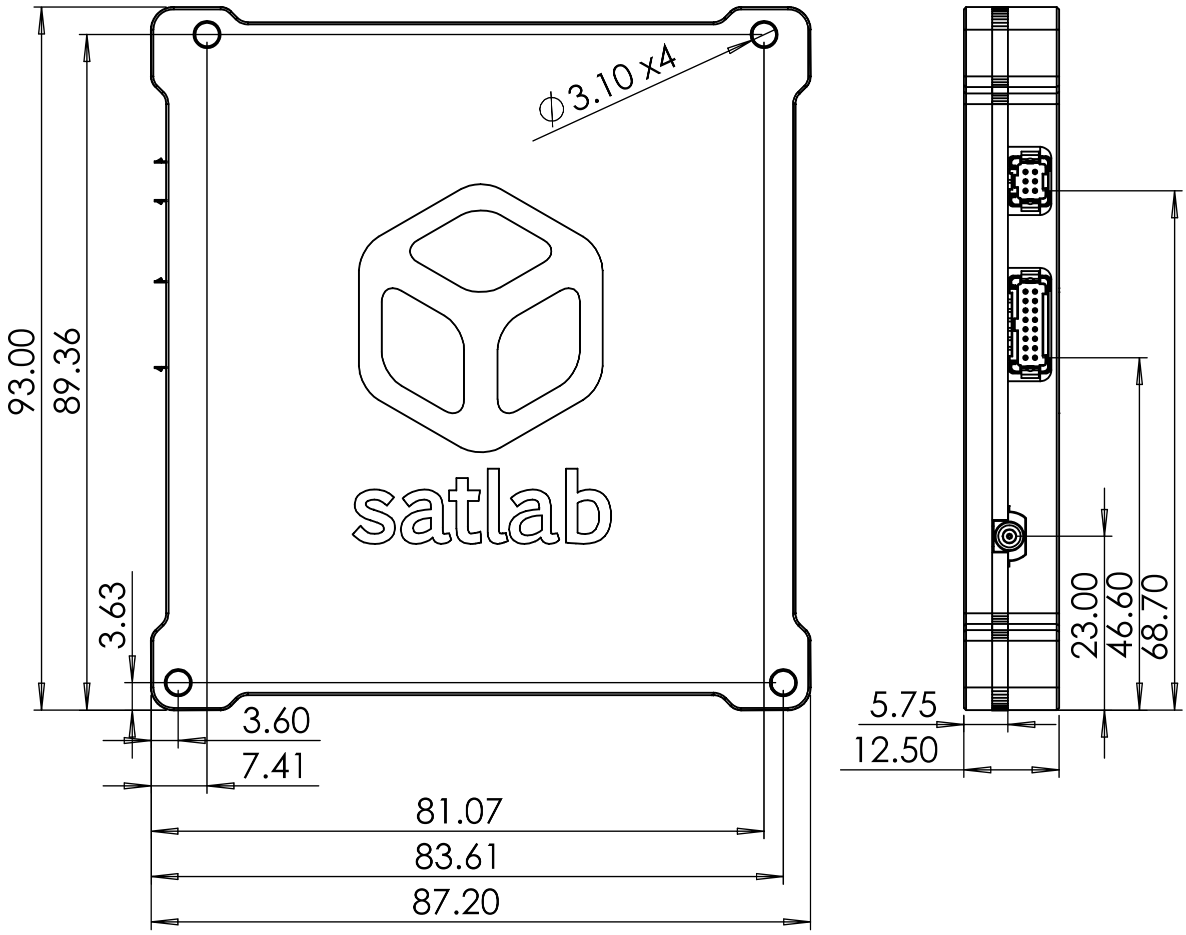


Figure 9: Board outline and side view. All dimensions in mm.

8 Ordering Options

As default, the Polaris AIS receiver is delivered with a PTFE flying leads cable for the main connector (P1) with all pins included and the connector potted. A USB EGSE adapter and serial interface is included for on-ground programming and testing on first order.

For contamination control and vibration protection, the PCB is coated with *Nusil CV-1152* conformal coating. If to be omitted, this can be selected below

The aluminum enclosure is normally delivered with *SurTec 650 ChromitAL TCP* chromate conversion coating (MIL DTL 5541, type II), but can optionally be delivered with *Henkel/Bonderite Alodine 1200S* coating instead (MIL DTL 5541, type I).

Satlab can deliver additional and/or customized cables upon request.

Polaris AIS Order Options		
CAN-bus termination	Do not include 120 Ω resistor	☐
RS-422 termination	Do not include 100 Ω resistor	☐
Conformal Coating	Do not conformal coat PCB	☐

9 Customization

Customized versions of Polaris AIS hardware and/or software tailored for specific customer requirements can be delivered at additional NRE cost. Please contact Satlab for more information about this option.

© 2025 Satlab A/S - https://www.satlab.com

10 Revision History

The document ID of this datasheet is **SLDS-POLARIS-1.1** and the revision number is **1.1**.

Revision	Issue date	Description
1.1	2025-02-12	Updated specifications for firmware version $\geq$2.0
1.0	2017-11-24	First released version for firmware version $\geq$1.0

11 Disclaimer

This datasheet is subject to change without notice. All information in the document is believed to be accurate and reliable at the time of publication, but it is presented without guarantee, warranty, or responsibility of any kind, expressed or implied. It is the responsibility of the customer to validate that the product with the properties described herein is suitable for use in a particular application. All trademarks are the property of their respective owners.